I measured fifty white and fifty brown spores (see Figs. 6 and 7), and the results were

White spores: 27–30 μ x 14–15 μ;

Brown spores: 25–30 μ x 12–15 μ.

The spores are, therefore, decidedly larger and especially broader than those of *Sphaeropsis malorum*.

Petrak and Sydow include *Sphaeropsis ulmicola* under *Botryodiplodia hypodermia* (Sacc.) Petr. and Syd. In my opinion this should not be done. The fungus I isolated from the Wisconsin twigs agrees closely with the description Ellis and Everhart give of *Sphaeropsis ulmicola*. As the description of Petrak and Sydow of *Botryodiplodia hypodermia* agrees with the third species of *Sphaeropsis* that I found on elm twigs, I propose the removal of *Sphaeropsis ulmicola* Ell. et Ev. from *Botryodiplodia hypodermia* (Sacc.) Petr. et Syd., and prefer to call it **Botryodiplodia ulmicola** (Ell. et Ev.), nov. comb.

Some inoculation experiments were carried out with *S. ulmicola* on young elm trees, in the same way as with *S. malorum*. The inoculations were made in November and December 1929, and in January, February and April 1930, always in the greenhouse. On August 20, 1930, several inoculated saplings were examined, but only in two cases out of twenty-six was a slight discoloration of the wood visible. Six small pieces of these saplings, excised just at the region of inoculation, were sterilized, peeled and placed in a petri dish with agar, as has been described already. In all cases a fungus, similar in its vegetative growth to *S. ulmicola*, was isolated from the wood. Though no spores were immediately produced two of the transfers of these cultures that were taken back to Holland have since produced typical spores of S. *ulmicola*. In two instances small pieces of the saplings, taken just above the points of inoculation, were treated in the same way, but no fungus similar to *S. ulmicola* could be isolated. Therefore, while the fungus was apparently still alive in the wood, it did not make any progress in the suscept beyond the inoculation court.

III. A third species of *Botryodiplodia* I found only on dead twigs of *U. foliacea suberosa* in the Arnold Arboretum of Harvard University. A great many of the young twigs of this tree had died, but this apparently did not seriously interfere with the vigor of the tree, as immediately below the dead twigs new ones were formed, and the trouble did not spread to the thicker twigs. On the dead twigs pycnidia were present, filled with spores. It was easy to fish these spores from a drop of water with a glass needle and deposit them in a petri dish. They germinated readily and soon the

mycelium could be transferred. Growth on prune agar was usually meager, but on sterilized elm twigs pycnidia with spores were formed in about 15 days.

This fungus agrees with *Botryodiplodia hypodermia* (Sacc.) Petr. et Syd. The occurrence of hyaline spores is more prevalent in this fungus than it is in *B. ulmicola.* Nearly all the spores are hyaline, in nature and in the cultures. When I first studied it I did not find any brown spores. It was only after some time that I detected them both on the twigs and in cultures initiated with single hyaline spores. The brown spores are nearly always two-celled. One-spore cultures from brown spores are identical with one-spore cultures from white spores; both yield white and brown spores again. I measured 50 spores each from twigs and from various one-spore cultures (see Figs. 8–13), and found the following sizes:

Hyaline spores from twig *a:* 29–34 μ x 15–18 μ;

Brown two-celled spores from twig *a:* 26–31 μ x 15–18 μ;

Monosporic culture from twig *a*, brown spores: 35–39 μ x 15½–17½ μ;

Monosporic culture from twig *a*, hyaline spores: 29–34 μ x 16–19 μ;

Hyaline spores from twig *b:* 26½–30 μ x 16½–20 μ;

Monosporic culture from twig *b*, brown two-celled spores: 32–37 μ x 15–17 μ;

Monosporic culture from twig *b*, hyaline spores: 34–37 μ x 16–17 μ;

Hyaline spores from twig *c:* 26–29 μ x 15½–18 μ;

Monosporic culture from twig *c*, brown two-celled spores: 27–32 μ x 15–18 μ;

Monosporic culture from twig *c*, hyaline spores: 32–37 μ x 16–19 μ.

Though the sizes are variable, they agree fairly well, at least in breadth, with those given by Petrak and Sydow for *Botryodiplodia hypodermia* (20–32 μ, mostly 25 μ x 15–18 μ, rarely to 21μ—Petrak and Sydow). According to Petrak and Sydow the spores remain continuous. It was my experience, however, that the brown spores are nearly always two-celled.

The abundance of the pycnidia in culture is a difference to be noted as between *Botryodiplodia hypodermia* and *B. ulmicola.* But the main difference is in the breadth of the spores, as the spores of *B. hypodermia* are considerably broader than those of *B. ulmicola.*

Inoculation experiments with this fungus on young elm trees in the greenhouse resulted with some success. Text figure 1 shows a small canker on young American Elm, caused by an inoculation with *B. hypodermia.* Another inoculation on the same tree resulted

in an inconspicuous canker. When the saplings were examined on August 20, 1930, two out of eight other inoculations, made in April 1930, proved to have been partly successful. In one case a small canker was formed, in the other a white line of demarcation could be seen about half a centimeter from the inoculation wound that separated the diseased from the healthy tissue. Cultures were

Text figure 1. Canker on elm sapling resulting from inoculation with Botryodiplodia hypodermia. It carries pycnidia with spores. Inoculation made Nov. 13, 1929; picture taken Aug. 29, 1930.

made from the region of all these points of inoculation to investigate whether the fungus was still alive, even if no canker had been formed. In seven out of eight cases a fungus could be reisolated that was similar in its vegetative growth to *B. hypodermia*. A culture of some of these reisolations I took with me when I left the United States, and pycnidia with *Botryodiplodia* spores have appeared in them since.

An apple, inoculated with *B. hypodermia* did not show any symptoms of decay for a long time. But at last it rotted in a character-

istic manner, as the tissues below the points of inoculation began to sink away. Deeply sunken spots eventually developed and continued to extend into the flesh of the apple. This fungus was, therefore, demonstrated to be pathogenic to the Elm, and to differ from *B. malorum* in its attack on fruits of the Apple.

This research was carried out while the writer was holder of a fellowship of Radcliffe College, Cambridge, Mass. She gratefully acknowledges her indebtedness to Professor J. H. Faull for encouragement during the progress of the investigation, to the Supervisor of the Arnold Arboretum for the provision of material, and to the Department of Botany of Harvard University for laboratory facilities.

SUMMARY

As an adjunct to my researches on the European Elm Disease I have made studies on "die-back" diseases of Elms in America.

From cankers of three such diseases, the first two from *Ulmus americana* and the third from *U. foliacea suberosa*, I isolated a different species of *Botryodiplodia* in each case, namely, *B. malorum*, *B. ulmicola*, and *B. hypodermia* respectively.

These fungi were studied in natural cankers and in cultures. Each was found to produce two types of spores, both in cankers and in monosporic cultures, namely, one-celled and two-celled spores. The latter are commonly brown in color.

Botryodiplodia ulmicola (Ellis and Ev.), n. comb., heretofore included under *B. hypodermia* by Petrak and Sydow, has been separated as a distinct species.

Elm saplings were inoculated in the greenhouse with spores from each of the three species of *Botryodiplodia*. The spores germinated and an infection resulted in each case. During the course of the experiment the mycelia of *B. malorum and B. ulmicola* persisted at the inoculation court in a living condition, but did not cause cankers. The mycelium of *B. hypodermia*, however, invaded tissues adjacent to the inoculation court and caused typical cankers.

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Pathological Laboratory, Arnold Arboretum,
Harvard University.

EXPLANATION OF PLATES 38 AND 39

1. *Botryodiplodia malorum*. Spores from apple twig. × 533.
2. *B. malorum*. Spores from elm twig (Arnold Arboretum). × 533.
3. *B. malorum*. Spores from canker on elm twig (Lexington, Mass.). × 533.
4. *B. malorum*. Spores in culture. × 533.
5. *B. malorum*. Two-celled spores in culture. Taken from a monosporic culture in which there are many two-celled spores. × 533.
6. *B. ulmicola*. Hyaline spores taken from a monosporic culture.
7. *B. ulmicola*. Brown spores from culture. × 533.
8. *B. hypodermia*. Hyaline spores from elm twig. × 533.
9. *B. hypodermia*. Brown spores from elm twig. × 533.
10. *B. hypodermia*. Hyaline spores taken from a monosporic culture. × 533.
11. *B. hypodermia*. Hyaline spores taken from a monosporic culture. × 533.
12. *B. hypodermia*. Brown spores taken from a monosporic culture. × 533.
13. *B. hypodermia*. Brown spores taken from a monosporic culture. × 533.

NOTES

The Arnold Arboretum during the Fiscal year ended June 30, 1931.

The Arboretum.—The summer of 1930 was characterized by a serious drought. Artificial means of watering were attempted where the plantations were in obvious need of moisture, but it was impossible to meet the requirements of every plant or to do more than supply the minimum of relief to rare or unfavorably situated specimens of trees and shrubs, yet the injuries caused by the drought were not serious.

The winter was mild and proved favorable in that the ground was covered with snow for much of the time. The mildness of the winter was evident in the profusion of flowers produced by the Cherries and allied groups, and in the slight or negligible injury to the flower buds of the less hardy introduced trees and shrubs.

In the late spring the effects of the drought of the preceding summer became manifest in the abundance of dead wood that had to be removed from the trees and in the necessity for severe pruning among the shrubs. Copious rains in June, records for rainfall for the month being broken, were extraordinarily beneficial.

The "Bulletin of Popular Information" goes to 1,932 subscribers. It has proved to be a valuable medium for spreading information with regard to the behavior of woody plants that have proved hardy in the climate of Boston. Eighteen numbers were issued in 1930.

The "Journal of the Arnold Arboretum" is widely circulated,

being issued to 300 subscribers and scientific institutions at home and abroad. It has proved to be a valuable medium of exchange with other libraries and we are indebted to it for many serial publications that are received by the Library of the Arnold Arboretum. Beginning with the twelfth volume (1931) the format and paper of the "Journal" were changed and the editorial work given to Alfred Rehder as editor and to Professors Faull and Sax as associate editors.

Between July 1, 1930, and June 30, 1931, to countries in all parts of the world 1,812 packets of seed were distributed and in the same period there were sent to institutions and individuals in the United States, Canada, Great Britain, Holland, Germany, Poland and Austria 1,097 cuttings. In the United States, Great Britain and Holland there were distributed 1,780 plants. In exchange there were received from New Zealand, the United States and countries in Europe, Asia, and South America 321 packets of seeds and 10,492 plants and cuttings.

At the end of this report there is appended a bibliography comprising the publications of the staff and students in the period covered between July 1, 1930, and June 30, 1931. This bibliography cogently shows the extent and nature of the investigations that are being undertaken by the Arnold Arboretum in the realm of botany and horticulture. It is worthy of note that several of the publications listed have been copied almost verbatim in foreign journals and have thrown new light on perplexing problems.

Visitors to the Administration Building numbered 1,178, representing Scotland, England, Ireland, New Zealand, Sweden, Germany, France, Russia, South Africa, India, Poland, Bulgaria and 35 of the United States.—O. A.

Pathological Laboratory.—Many requests for information on plant diseases were received by the Pathological Laboratory during the past year. These have pertained to a wide range of host species and diseases, and have referred to individual trees or shrubs, entire plantations and to forest areas covering tens of thousands of acres. To the exceptional inquirer interest centers in the disease itself, but generally the main concern is to learn how the disease may be eliminated, controlled or prevented. The Arboretum welcomes both types of inquiries, though sight is never lost of the fact that the ultimate ideal of its pathological division is the accumulation of data on the ways in which the conflicting factors that beset ornamental plants or forests, may be adjusted to permit normal development. (J. H. FAULL, The Health of the Forest. *Forest and Outdoors*, **26:** 146–149. 1930.)

Another phase of our work has to do with aid given to students of pathological problems. During the year we have had seven of these, who have come to us from the United States, Canada and Europe.

The investigational activities for the year have been varied and substantial progress can be reported on several of the projects undertaken. Naturally the number of subjects under investigation at one time is limited, not by the number that call for research, but by man power and financial support. We have received heartiest co-operation from the Supervisor and some material aid from outside. A summary of the more important topics follows.

1. DISEASES OF CONIFERS. Several weeks were spent in the forest on a study of trunk diseases of Spruce, their causes, their relative frequency of occurrence, relation to age of the trees, the conditions that under-lie their spread, closer utilization and control. Investigations on these and certain other coniferous diseases have been continued in the laboratory.

2. ELM DISEASES. Dr. Christine Buisman of Holland, who, as reported last year, first positively identified the occurrence of the Dutch Elm disease in America, studied various native diseases of Elms while at the Arboretum. Certain results of her work are recorded in this number of the Journal of the Arnold Arboretum.

3. GRAFT BLIGHT OF LILACS. An important part of Dr. K. S. Chester's work on this disease was completed during the year. He was able to demonstrate the cause as involved in the common practice of propagation of Lilacs on privet stocks, a practice that has arisen, not through necessity but because of its somewhat lower cost. His work is bound to be a valuable aid to the lilac industry and to private growers. (K. S. CHESTER, Graft-Blight: A Disease of Lilac Related to the Employment of Certain Understocks in Propagation. *Jour. Arnold Arboretum*, XII. 79–146. 1931.

4. STUDIES ON GANODERMA. The greatest confusion has prevailed with reference to the taxonomy of a group of wood-attacking fungi, on both hardwoods and softwoods, of the genus *Ganoderma*. An excellent piece of work by W. R. Haddow, based on a comparative study of distictive characters has revealed what appears to be the key to a correct understanding of the species concerned. (W. R. HADDOW, Studies in Ganoderma. *Jour. Arnold Arboretum*, XII, 25–46. 1931.)

5. AN EPIDEMIC OF BEECH. The devastating epidemic on Beech in Nova Scotia has spread across the border into New Brunswick. Mr. John Ehrlich has begun his second year of study on this disease and finds that it results from a joint attack of a Coccus insect and